ORGANIC CONTAMINATION BEHAVIOR ON THE SILICON WAFER SURFACE STORED IN NEW TYPE PLASTIC POD UNDER REDUCED PRESSURE

Teruyuki Hayashi**, Yukihiro Kanechika*, Takashi Kawaguchi*, Naoki Tanahashi*, Yoshihide Wakayama****, Misako Saito***, Yasuyuki Shirai*, Masaki Hirayama**, Shigetoshi Sugawa**, and Tadahiro Ohmi*

* New Industry Creation Hatchery Center (NICHe), Tohoku University

**Department of Electronic Engineering, Tohoku University 05 Aza-Aoba, Aramaki, Aobaku, Sendai 980-8579, Miyagi, Japan

***Tokyo Electron Ltd., Technology Development Center, 650 Mitsuzawa, Hosaka-cho, Nirasaki, Yamanashi, 407-0192 Japan

****Taisei Corporation,344-1-Nase-cho, Totsuka-ku,Yokohama, 245-0051, Japan

Introduction

Bottom opening removable pod (BORP) load-unload system which is consolidated with wafer transportation system has been developed by Tohoku University as a next generation silicon wafer load-unload system [1]. The system makes it possible to drastically reduce the required process space because of eliminating wafer transportation robot system as used for FOUP system. And now, it has been known that organic contaminants adsorbed on a silicon wafer surface cause many detrimental effects [2]. BORP system is also able to prevent the organic contamination perfectly. BORP is made of a transparent plastic to decrease its weight and it is used under reduced pressure, at around few hundred torr, to retain the bottom lid while wafers are storing (Fig.1). Opening and closing of the lid are performed under reduced pressure in the load-unload chamber. Therefore, silicon wafers in BORP are always exposed under reduced pressure. Organic contamination on the stored silicon wafer is concerned due to the organic outgas released from a plastic pod itself.

This study reports on an organic contamination behavior on a silicon wafer surface stored in a plastic pod under reduced pressure.

Experimental

The BORP was made using two kinds of plastics, cyclic - olefin – polymer (COP), and polycarbonate (PC) (a current standard material for front opening unified pod). Two gas feed nozzles with valves were attached on the bottom lid to control the inner pressure of BORP (Fig.2). A silicon wafer with thermal oxide was set on the bottom lid, then covered using BORP. After the BORP was set, the inner pressure was controlled between 3 Torr and 760 Torr at 55 degrees C. The adsorbed organic contaminants concentration on the exposed silicon wafer in BORP was measured by TD-GC-MS.

Results

GC-MS chart for organic contaminants on the silicon wafer stored in both COP BORP and PC BORP at 100 Torr are shown in Fig.2. The relation between the BORP inner pressure and the adsorbed organic contaminants concentration on the exposed silicon wafer surface is shown in Fig.3.

The vapor pressure of the organic contaminants only depends on the temperature if the vapor of organic contaminants released from the surface of the material is in accordance with the Clausius-Clapeyron's equation. The molar fraction of the organic contaminants in BORP inner gas is inversely proportional to the BORP inner pressure when the vapor pressure is not changed under the constant temperature.

Organic contaminants were hardly adsorbed on the silicon wafer surface stored in COP BORP as was detected by GC-MS (Fig.3) when the inner pressure condition was more than 100 Torr. The amount of adsorbed organic contaminants on a silicon wafer surface stored in COP BORP was inversely proportional to the BORP inner pressure when the pressure was under 100 Torr. Therefore, the amount of the contaminants on a silicon wafer surface stored in COP BORP depends on the molar fraction of organic contaminants in the total inner gas when pressure is extremely low. On the other hand, the amount of the contaminants on a silicon wafer surface stored in PC BORP did not depend on the inner pressure. This means that the contaminants saturate on the silicon wafer surface because excessive amounts of organic gases from PC BORP are released. Therefore, there is no correlation between the amount of adsorbed the contaminants on a silicon wafer surface stored in PC BORP and the molar fraction of organic gases in the inner gases because excessive organic contaminants exist in the inside of PC BORP.

It is clearly demonstrated that the lower organic outgas material like COP must be used as pod material. However, when the pressure is less than 100 Torr, the organic contaminants on the wafer surface are gradually increased because the molar fraction of organic contaminants increases even if the purest material, like COP, is adopted. This indicates that exposing silicon wafers under high vacuum atmosphere makes the contamination to significantly deteriorate the quality.

References

[1] T.Ohmi et al, 2001 IEEE ISSM, pp.481-484, October 2001
[2] T.Ohmi et al, IEDM meeting, pp.751-754, December 1996

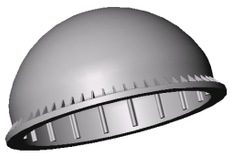

Fig.1 BORP(Bottom Opening Removable Pod) Prototype for Experimental

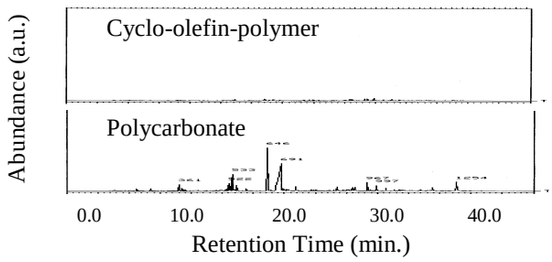

Fig.2. GC-MS chart for organic contaminants on a silicon wafer stored in both COP BORP and PC BORP at 100 Torr

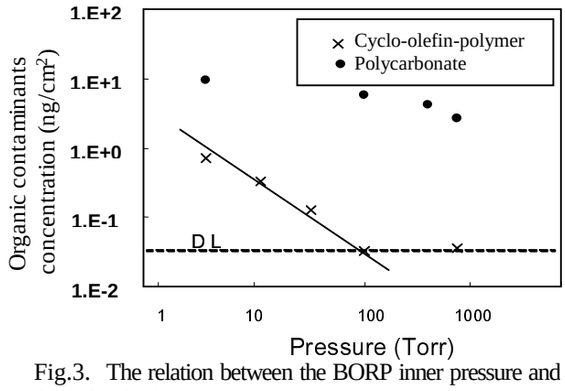

Fig.3. The relation between the BORP inner pressure and the adsorbed organic contaminants concentration on the exposed silicon wafer surface